Habitat Enhancement Project Update 12/22/05

<u>Current Status of the Site Selection Process:</u>

MarineFisheries has continued its site selection process for the placement of a cobble/boulder reef for habitat enhancement. After the initial elimination process outlined in the July 7, 2005 update, we reduced our original 24 potential sites down to 14 potential sites.

All 14 remaining potential sites were within 6.8 miles of the nearest harbor and in the 20 to 50 ft. MLW depth range. Therefore, all potential sites are considered accessible to recreational and commercial fisherman, scientists, recreational SCUBA divers, and other interested user groups. No sites were located within shipping channels marked on NOAA charts. Additionally, *MarineFisheries* discussed the habitat enhancement project with the Massachusetts Lobstermen's Association and we do not anticipate any adverse reactions from commercial lobstermen. No other commercial fishing activities are expected to occur in the vicinity of potential sites due to existing shellfishing closures and shallow, undesirable depths for large-scale fishing practices such as trawling. It is also important to note that no submerged aquatic vegetation (SAV) will be affected by the reef due to the targeted reef depth and substrate type.

We then conducted underwater transect surveys on the 14 remaining sites in order to determine the stability of the substrate and to classify and quantify the substrate into three main categories: primary substrate = the substrate type that constitutes more than 50% of the area, secondary substrate = the substrate type that constitutes between 10-50% of the area, and underlying substrate = the substrate type found underneath the primary and secondary substrate. Additional biological and physical data was collected including: species abundance and diversity and current direction. These data allowed us to avoid placing the reef on pre-existing productive habitat and ensured that the reef would be placed on substrate that we expect will be strong enough to prevent reef sinking.

Upon completion of these transect dives, 1 more site was eliminated and one of the alternative sites was substituted. In order to rank the remaining potential sites, *MarineFisheries* developed a weighting

Diver conducting transect survey

system to incorporate different aspects of the site selection criteria. Data used in this portion of the analysis included the primary substrate, secondary substrate, underlying substrate, sand ripple presence (an indicator of wave action), site proximity to the HubLine, and site proximity to cobble fill points along the HubLine. Prior to weighting the sites, each category needed to receive an individual numerical score that the ranking analysis could be based upon.

For example, each site was classified by the percentage of all sediment types recorded in the area. The primary sediment categories included boulder, cobble, pebble, granule, sand, shack (whole shells), shell debris, and silt. These sediment types were broken down into three numerical categories in order to describe their suitability for reef placement.

> *Category rating levels*:
>> 1 = Poor: boulder and silt
>> 2 = Potential: cobble (some cobble are small and flat and do not represent prime habitat for marine life)
>> 3 = Prime: pebble, granule, sand, shack, and shell debris

Each sediment proportion was multiplied by the assigned category rating of 1, 2, or 3. These values were then summed to provide a final primary sediment rating for that site.

The same sediment rating analyses were conducted for secondary and underlying substrates. A similar method was used to assign a numerical value to the other site selection criteria including:

Sand Ripple / Wave Action: We assumed that the presence of sand ripples on a site indicated areas of high wave energy which may be detrimental to reef placement. Therefore, sites were classified as either (3) low energy = no sand ripples, (2) moderate energy = small sand ripples (1-5 inch height) or (1) high energy = large sand ripples (> 5.1 inch height).

Proximity to HubLine: Sites that were closer to the HubLine were preferred. Therefore, sites were classified as either (3) adjacent to the HubLine pathway (< 100 ft.), (2) near the HubLine (100-499 ft.), or (1) far from the HubLine (500-1000 ft.).

Proximity to Fill Points: Sites that were closer to fill points were preferred. Fill points along the HubLine are considered to be areas that were highly disturbed by the installation of the HubLine. Sites were classified as either (3) adjacent to a fill point, (2) relatively near a fill point, or (1) relatively far from a fill point.

Each variable described above was weighted on a percentage scale according to their importance in the site selection process. *MarineFisheries* employees worked together to determine the most objective weighting system for the different selection categories (Table 1). The primary substrate variable was assigned the largest weight at 50% because this is the substrate that will be directly impacted by the installation of the reef and the sediment that will need to carry the majority of the reef's weight. If the potential site had a high percentage of productive habitat (i.e. "poor" reef substrate) this weighting category would automatically rank the site much lower than a site with mostly "prime" reef substrate. The other two

substrate categories were assigned weights of 15% to represent their importance in supporting the weight of the reef, as well as avoiding productive habitat. We assigned a weight of 10% to the presence of sand ripples as an indicator of wave action in the area. Although this variable is not as crucial as substrate, it is still important to take wave strength into account in terms of its ability to dislodge or bury the reef. Finally, the proximity to the HubLine and fill points received 5% weighting to account for our goal to place the reef near these areas if all other site selection criteria were met.

Table 1: Weighting categories

	Weight
Primary sediment	50%
Secondary sediment	15%
Underlying sediment	15%
Wave action	10%
HubLine proximity	5%
Fill point proximity	5%

Table 2: Weighting results

| Site Rank	Results
1st	20
2nd	29
3rd	11
4th	18
5th	23
6th	19
7th	4
8th	8
9th	6
10th	5
11th	17
12th	3
13th	14
14th	13

The final weighted scores were summed for each site. The sites with the highest scores were generally considered the best for reef placement, although species presence and abundance was not taken into account in this analysis (Table 2). Species abundance and diversity was taken into account by combining the results of this analysis with qualitative data from the species presence/absence records to determine the best final sites.

The ranking analysis and species presence/absence data provided us with two optimal locations for the habitat enhancement area within each of the three areas of consideration: (1) Marblehead, (2) near the Hypocrite Channel in Boston Harbor and, (3) near the Brewster Spit in Boston Harbor. We then conducted video surveys at these six sites. Additional transects were surveyed with the goal of assessing as much area as much as possible in the 1.7 acre footprints. This allowed *MarineFisheries* to assess the site's overall potential and species abundance and diversity. Upon the completion of these dives three final sites were selected: 6, 20, and 23.

When these site locations were sent to the MA Board of Underwater Archaeological Resources (BUAR), we were informed that Site 20 was located within a buffer zone of an area of archeological concern. Therefore, Site 29 (an alternative site) was substituted for the highest ranking site, Site 20. Site 29 still meets our site selection criteria, although it contains more cobble than Site 20, and it is outside of BUAR's recommended buffer zone. Therefore, the three final sites considered for the habitat enhancement project were Sites 6, 23, and 29 (Figure 1 and 5). General descriptions of each of these sites are included below.

Final Three Site Descriptions:

Site #6 in Marblehead is located adjacent to Cat Island outside of the shipping channel (Figure 1). The primary substrate at this site consisted of pebble, granule and sand. All three of these substrate types were targeted for potential reef installation because they support lower species diversity and abundance than cobble and boulder. The secondary substrate on this site again consisted of sand, pebble, and granule with a small percentage of cobble (Figure 2). We are not concerned with the small amount of cobble as secondary substrate because it was not found in densities high enough to create the interstitial spaces necessary to support high species abundance and diversity. The underlying substrate of sand and granule is
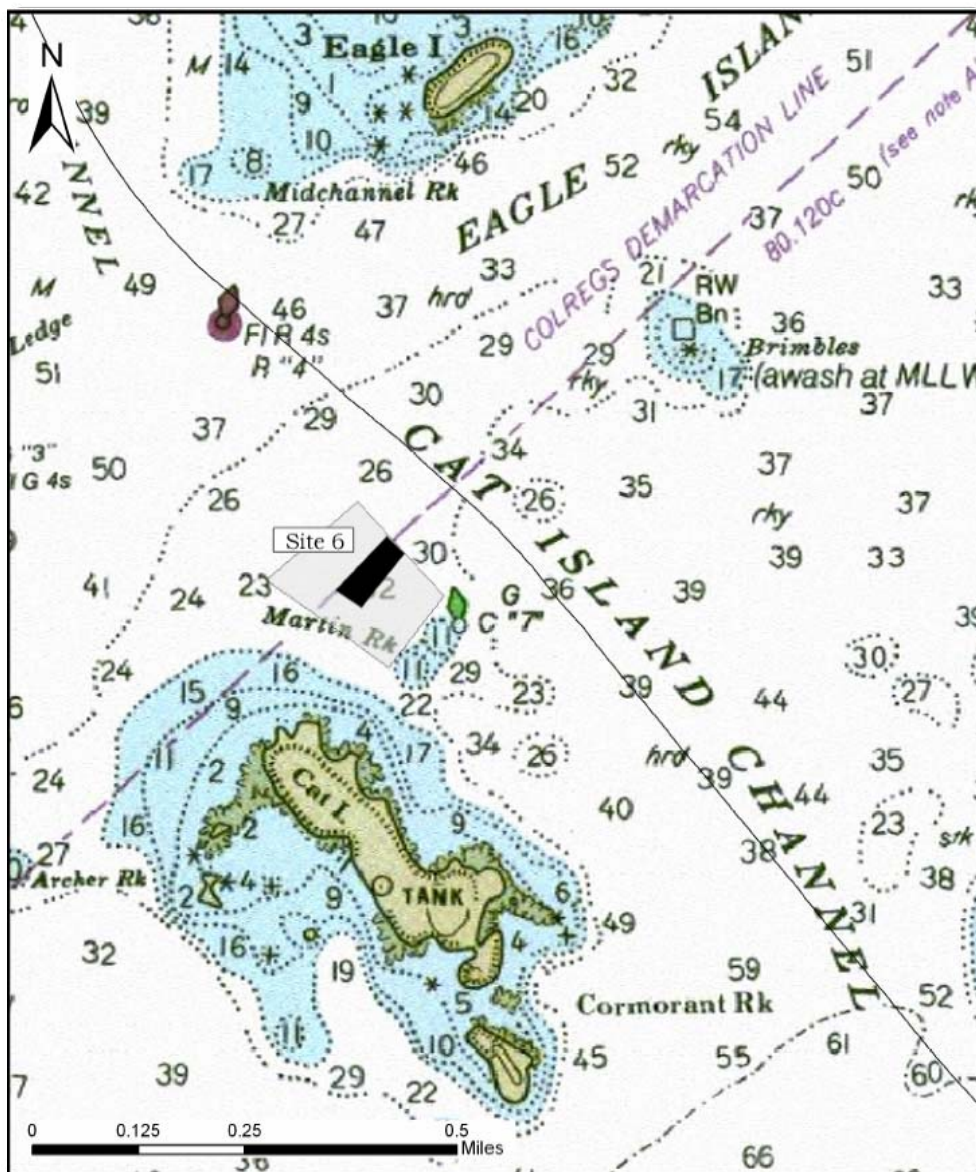

Figure 1: Location of Potential Habitat Enhancement Site in the Town of Marblehead

considered strong enough to support the weight of a reef. No species on this site were observed in abundances greater than 2-5 counts per 150 ft. transect. The only species seen of commercial concern were the sea scallop, rock crabs, and lobster, although only 2-5 individuals were counted in total for each species. There was a fair amount of drift algae (unattached to substrate) on the site, most likely the result of a strong Nor'easter that hit the region a week before sampling. Species abundance and diversity on this site was lower than that of all other potential sites in the Marblehead region.
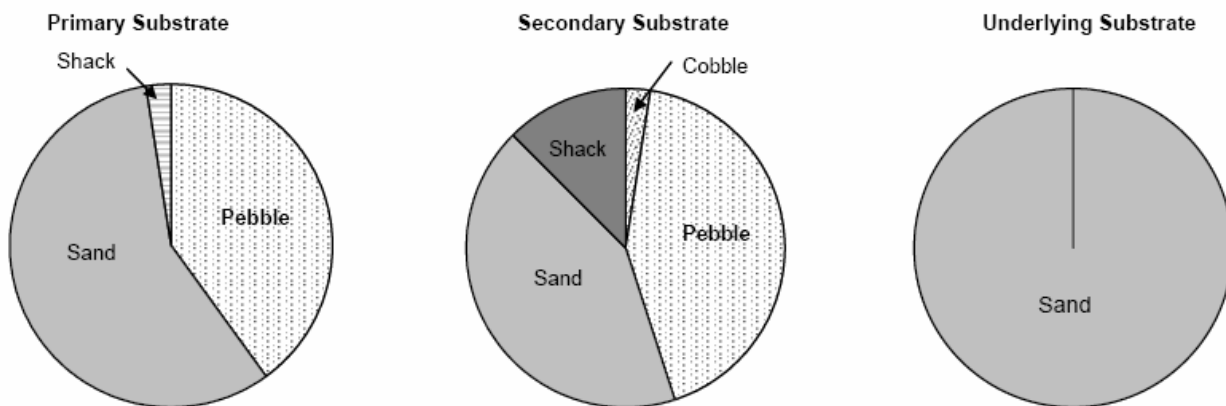
Figure 2

(A) Marblehead Site 6 Substrate Types

Primary Substrate   Secondary Substrate   Underlying Substrate
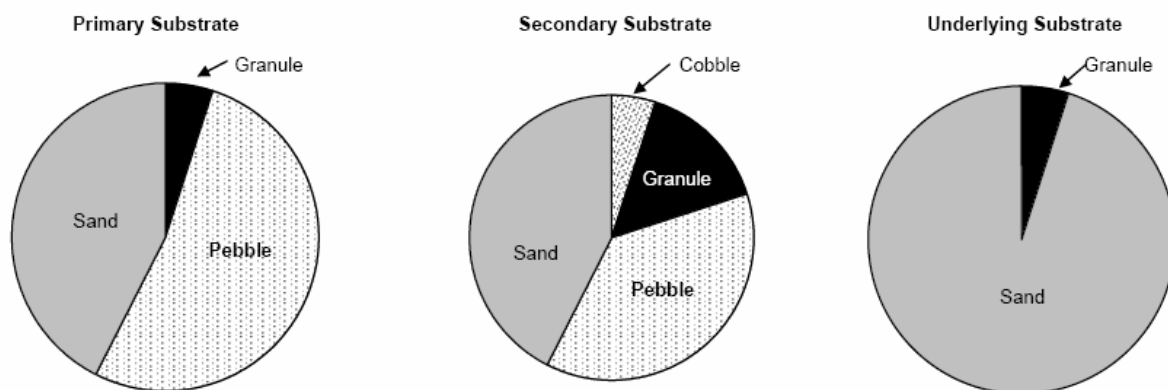
Site #23 is located just north of the Brewster Spit in Boston waters off Lovell Island (Figure 5). The primary substrate at this site is pebble and sand with a small percentage of shell shack. The secondary substrate also met our criteria for site selection, consisting primarily of sand, shack and pebble with a small amount of cobble (Figure 3). Again, we are not concerned with the small amount of cobble as secondary substrate because it was not found in densities high enough to create the interstitial spaces necessary to support high species abundance and diversity. The underlying substrate of sand is considered strong enough to support the weight of the habitat enhancement area. Two species of non-commercially important invertebrates, the horse mussel (*Modiolus modiolus*) and hydroids were recorded in high abundance (100-200 individuals) along sections of our 150 ft. transect dives. Other species recorded in very low densities (no counts greater than 6-10 along 150 ft. transects) consisted of *Cancer sp*. crabs, razor clams, lobster, burrowing anemones, sea stars, moon snails, young-of-the-year sculpin, sea scallop, skates, spider crabs, and winter flounder. Algal coverage was <1% of all species noted on all transects. We recognize that it will be impossible to find sites for the habitat enhancement area that are completely devoid of marine life. Despite this site ranking in the middle range of species abundance when compared to other sites, its species diversity is so low that this site ranked higher in preference than other sites in Boston near the Brewster Spit.

Figure 3

(B) Boston Site 23 Substrate Types

Site #29 in Boston is located just east of Lovell Island and just south of the Hypocrite Channel (Figure 5). The primary substrate here consists of sand and pebble and a small amount of granule. The secondary substrate is mostly pebble or sand with a small percentage of cobble and granule (Figure 4). Again, the cobble recorded here is not found in densities high enough to create substantial interstitial space and is, therefore, not expected to support high species abundance and diversity. The underlying substrate of sand is considered strong enough to support the weight of the reef. Although it contains more cobble than the original site for which it was substituted (Site 20 had 0% coverage of boulder or cobble), Site 29 still meets our site selection criteria and ranked second highest among all our final sites of consideration. Site 29 is also located directly adjacent to a highly impacted area of the HubLine where cobble fill was placed. When compared to other sites, species abundance and diversity were among the lowest at Site 29. Species that were noted in densities of 11-25 per 150 ft. transect included crabs (*Cancer sp.*) and sponges (*Isodictya palmata*). Species noted in low densities (1-10) included lobster, sea stars (*Henricia sp.*), young of the year sculpin, skates, and burrowing anemones (*Cerianthus borealis*). Algal coverage was <1% for kelp and a thin diatom film was noted to be covering 25-50% of the pebble and sand substrate.

Figure 4

(C) Boston Site 29 Substrate Types
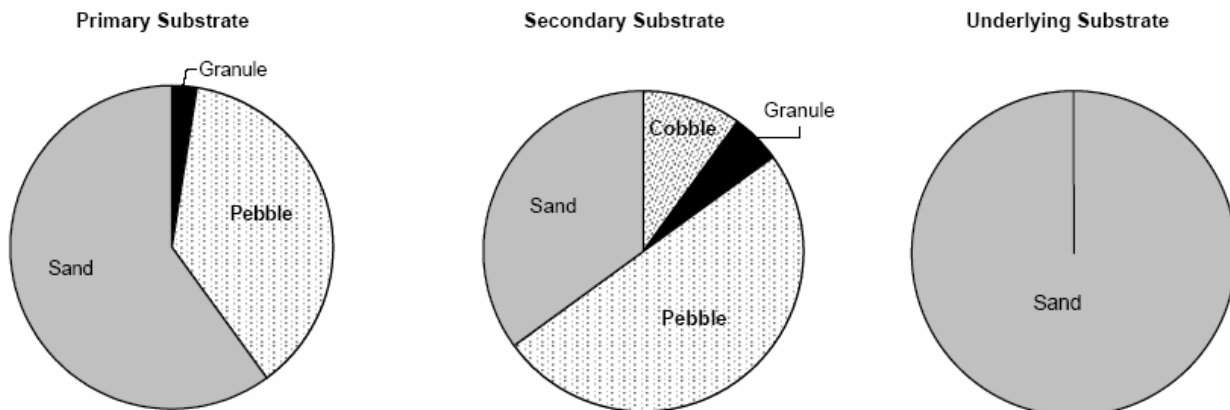
In addition to these three potential sites, each site has a marked "shifting" zone around it. This shifting zone represents a margin for placement of the 0.59 acre enhancement area which will be utilized to move the reef if we discover an area of high productivity or diversity that our initial surveys did not record. No site will be shifted unless we encounter a previously unknown area of high diversity within the current site boundaries.
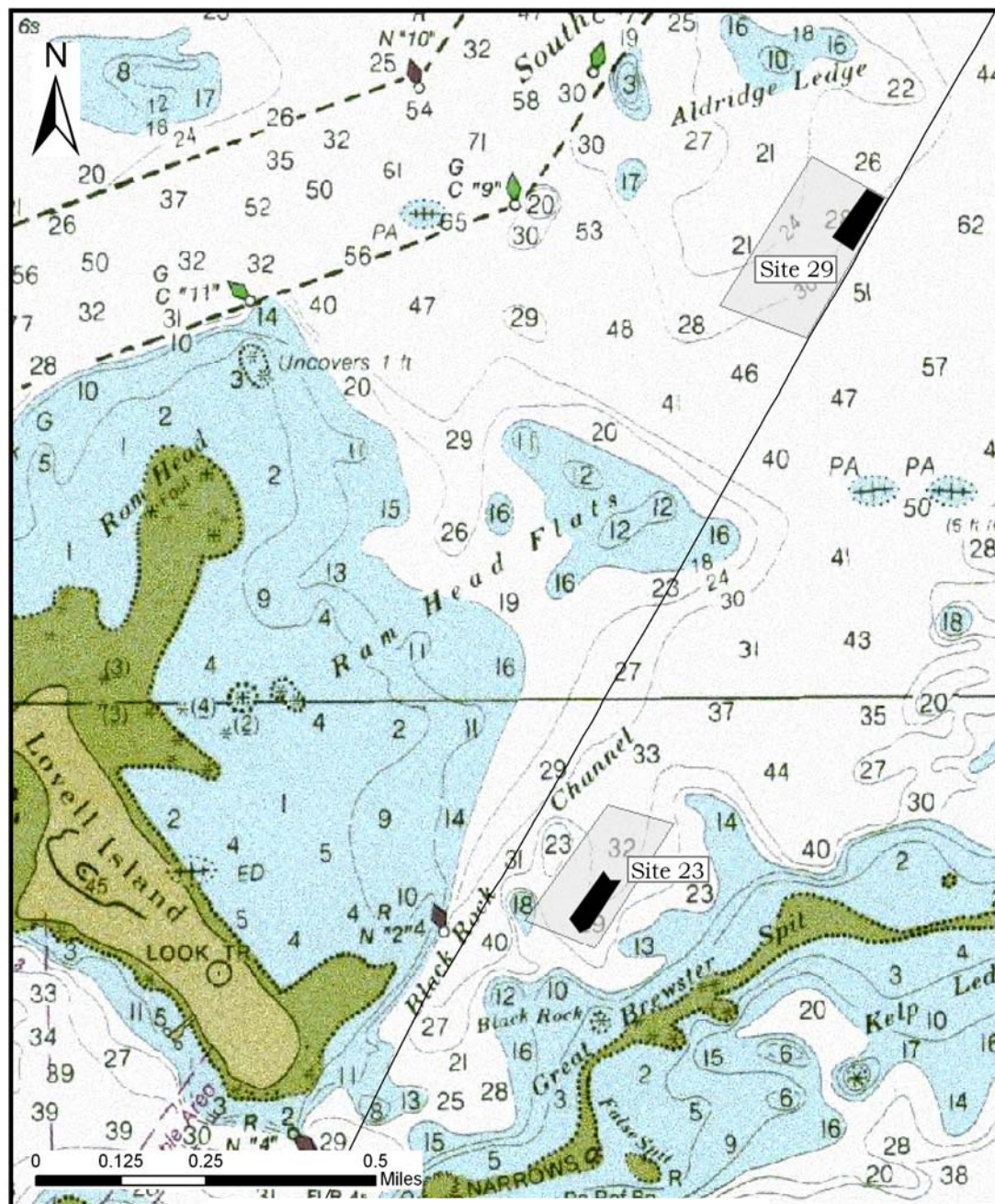

Figure 5: Location of Potential Habitat Enhancement Sites in Boston Harbor

The dashed line represents potential shifting areas that these sites may require in order to avoid productive areas. Shifting will only occur if necessary and the final reef size will not change.

Legend:
- Hubline
- Site ID
- Shift Zones

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After selecting these three sites, we set out to determine if these sites would have the presence of a natural larval supply. We accomplished this using two different methods: (1) suction sampling natural sediments at both the potential reefs as well as nearby natural reefs and (2) deploying settlement collectors on the reef sites.

We wanted to suction sample each site in order to gather quantitative data on species present at the sites as well as presence/ absence data on particular benthic and encrusting species and algae at each site. The suction sampling device consisted of a PVC lift tube supplied with air from a SCUBA tank. Samples were air-lifted into a mesh nylon bag attached to the upper end of the suction tube. We suction sampled six sites for comparison: the three potential reef sites, two nearby natural reefs, and the HubLine fill point near Site 29. At each

Diver suction sampling a 0.5m^2 quadrat

site, 5.3 ft^2 quadrats were haphazardly placed on the substratum at least 6 feet apart until a total of 12 replicates were completed at each site.
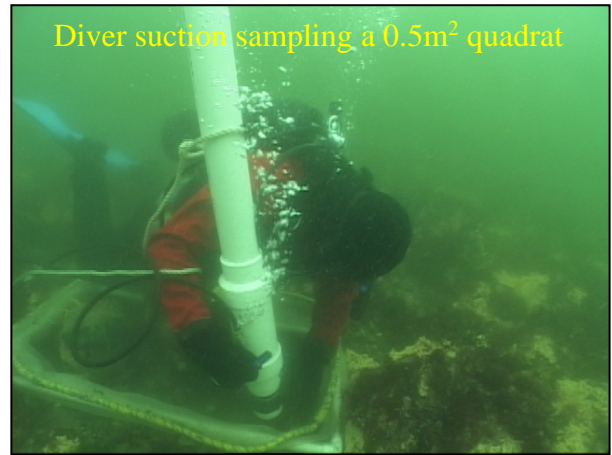
MarineFisheries also needed to know if larval settlement occurred in the areas being considered for habitat enhancement. All three potential reef sites were naturally lacking in prime larval settling habitat (cobble and boulder), and thus had naturally low larval settlement. Therefore, we designed 24" square mesh larval settlement collectors filled with cobbles and boulders to create temporary prime habitats within the area of the potential reefs. The collectors allowed us to determine if larvae would settle in these areas when provided with the correct habitat. Astroturf was placed on the bottom of each collector (for "underlying substrate") and covered with cobble and small boulders. With the cooperative

Square wire mesh larval settlement collectors

help of contracted lobstermen, 10 collectors were placed on each site. Collectors were deployed in July before larval lobster settling season in Massachusetts Bay and retrieved at the end of September, which was close to the end of the larval recruitment season.

All flora and fauna were carefully inspected, counted and recorded on the surface. Larval crustaceans, such as young-of-the-year lobsters and crabs, were included in these counts. Species that were not readily identifiable in the

Young-of-the-year American lobster
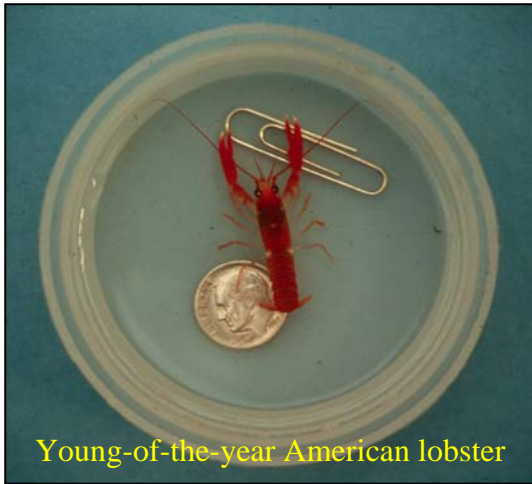
field were preserved in alcohol and keyed out in the lab using a dissecting microscope.

Suction Sampling and Settlement Collector Results:
All three potential sites had no natural larval lobster settlement, although they did have a natural supply of other crustacean larvae (Figure 6). The suction sampling results also show that Sites 29 and 23 have higher species abundance than Site 6. However, Site 6 has higher species diversity than the other sites, where Site 29 has the lowest species diversity of all the sites (Figure 7). The two natural reefs had higher species diversity than all the other sites that were suction sampled. The HubLine fill point had the highest species abundance, although the species diversity was extremely low, consisting primarily of small whelks and crustacean larvae (Figure 7). We did record the presence of larval lobsters on both of the natural reefs and the HubLine fill point near Site 29.

Results from the settlement collectors were also similar to the suction sampling. Our primary goal with the settlement collectors was to look for the presence or absence of lobster larvae, as well as evidence of settlement of other species. Site 29 and Site 6 had no larval lobster settlement, while Site 23 did experience lobster settlement. We did record, however, larval settlement for other fish and crustacean species on all three sites using the settlement collectors.

We hypothesize that the lobster settlement at Site 23 was due to the high sedimentation rates we found in the collectors. This, most likely, made the collector "habitat" more preferential for larvae because it allowed larvae to excavate shelters under the rocks. However, it also indicated that if we placed an artificial reef at this site there was high potential for siltation and reef burial. Site 29 and Site 6 did not experience these high siltation rates in the collectors.

Despite the presence of larval lobsters, we eliminated Site 23 due to the high siltation rates and concern for reef burial. This left Site 29 in Boston Harbor and Site 6 in Marblehead as the final sites considered for the reef. Both sites had no larval lobster settlement in their collectors, yet the suction sampling results from the natural reefs (which are in the same vicinity as these two reefs) demonstrate that larval lobsters are present near the sites. Additionally, Site 29 is within 10m of the suction sampled HubLine fill point area, which also experienced larval lobster and crustacean settlement. Thus, we concluded that although larval lobsters were not present in the settlement collectors, we would expect larval lobster settlement on either of these sites.

Figure 6: 2005 Average Density of All Crustaceans (Including Lobster) By Site
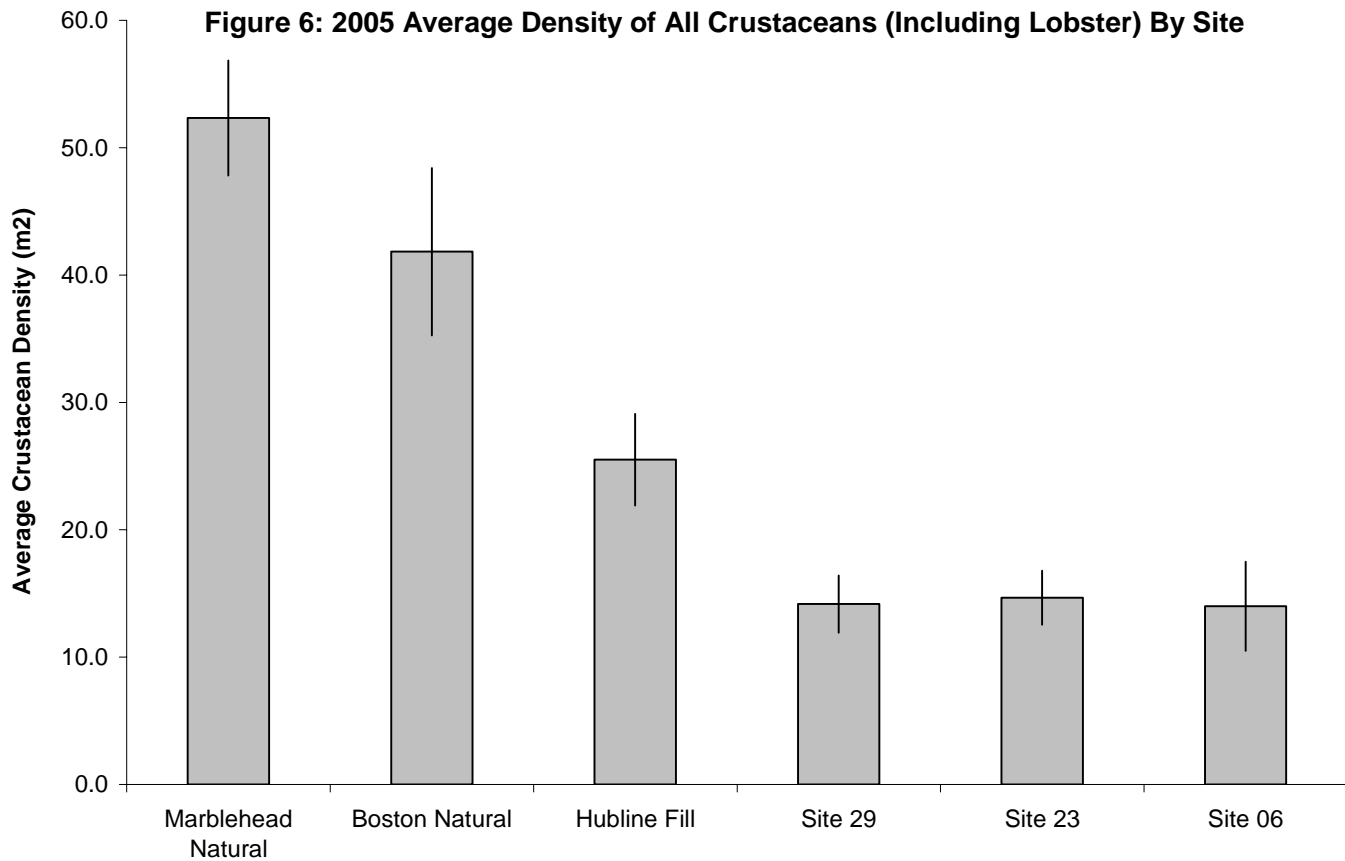
Figure 7: Average number of individuals per quadrat per site
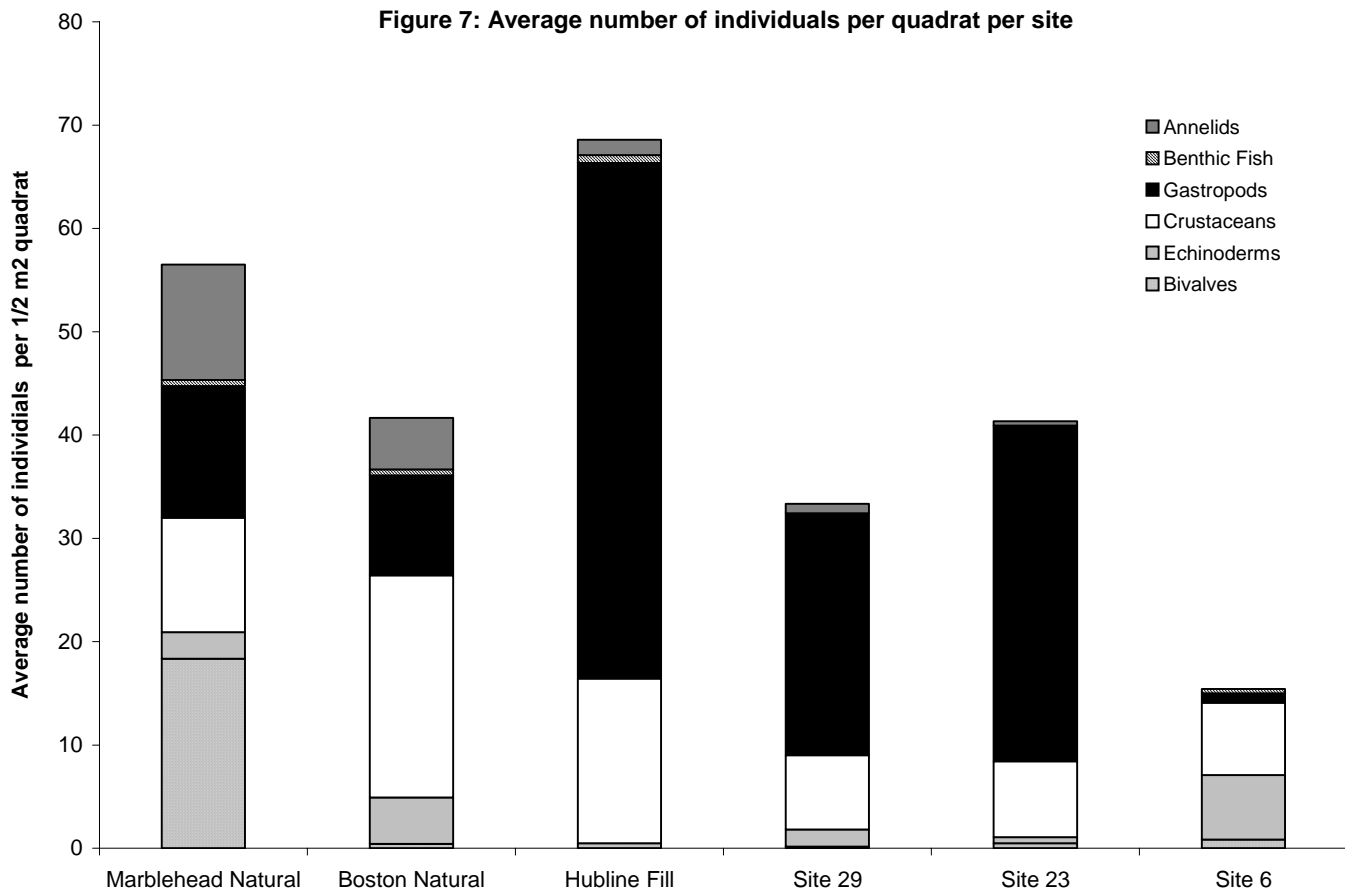
Although both of these sites were equal in terms of larval settlement, we still wanted to consider overall species abundance and diversity at these two sites. We ran species abundance and diversity analyses on the suction sampling data from all sites in order to confirm our observations from the graph (Figure 7). Based on these results, Site 6 provided the highest measure of species richness, the percent species representation within the community sampled. The Marblehead natural reef provided the highest measure of heterogeneity (species richness combined with the number of species in the sampled community) followed by the Boston natural reef. The lowest species richness occurred at Site 29.

At this point, we felt that we had collected enough information from the sites and could make an informed selection of the best area for the habitat enhancement. Site 29 clearly met the majority of the site selection criteria, as opposed to Site 6 (Figure 8). Site 29 was the closest to the HubLine, the closest to a HubLine fill point, received little wave action, had no slope, was at a good depth (31 ft. MLW), had low species diversity and abundance, had a natural larval supply, and would be more cost effective than Site 6 (based on contractor bids).

View of Site 29 from the surface with Calf Island in the background

Construction Plans

Upon completion of the site selection process *MarineFisheries* solicited bids from independent contractors for reef construction.

The contractor will be responsible for obtaining clean reef materials from local quarries. Rocks will be blasted cobble and boulder. All rocks will be cleaned of silt and sediment outside of coastal resource areas prior to transportation and installation. We expect at least 95% of the cobble and boulder material to be within one of the four specified size categories. *MarineFisheries* will independently inspect reef materials to ensure adherence to rock size specifications prior to deployment on the site. Contractors will be responsible for transporting all materials to the site. No waste or scrap materials (such as concrete) will be used on the reef.
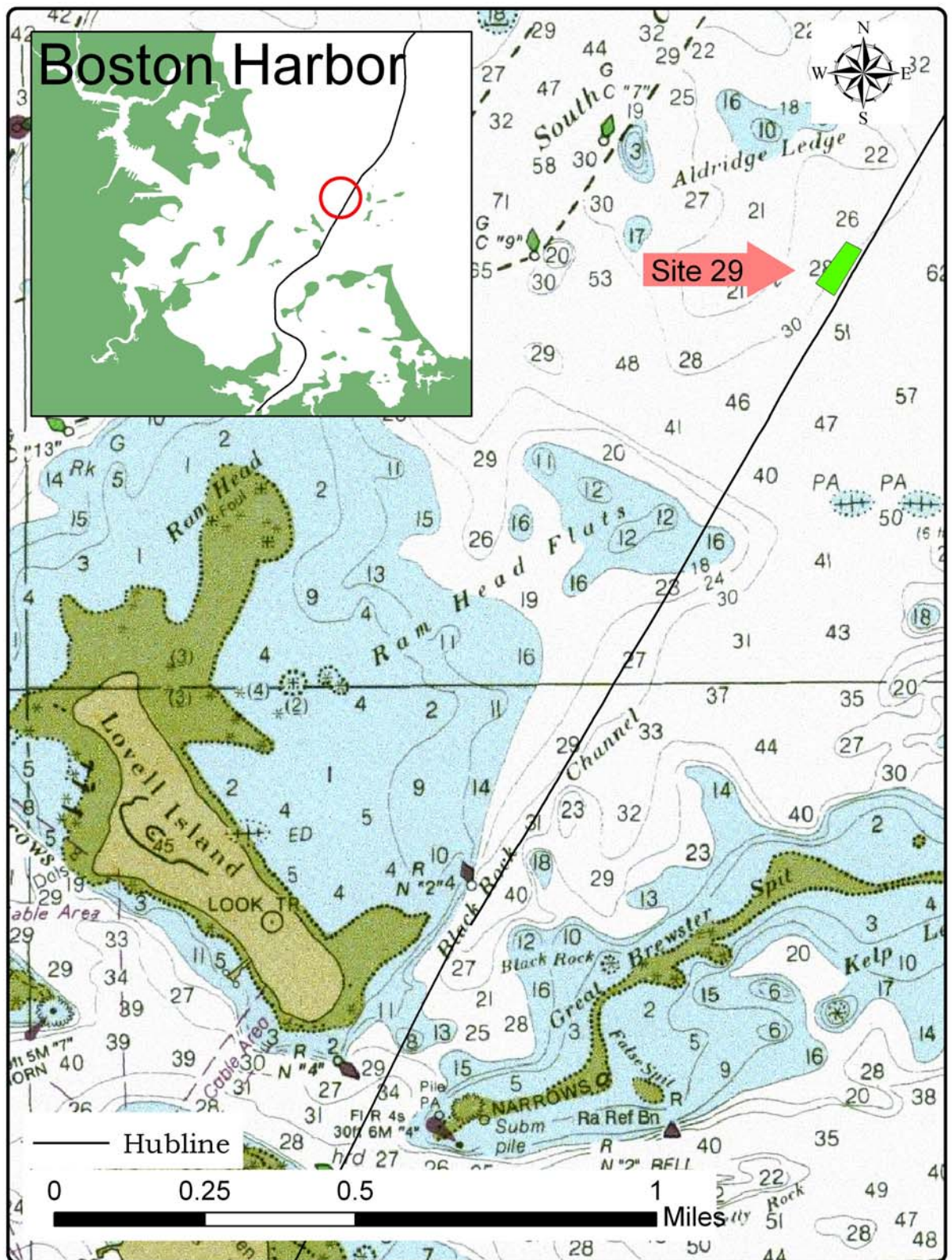
Figure 8: Proposed location for the habitat enhancement project

The contractor will be responsible for the following tasks, however, *MarineFisheries* will oversee the construction process to ensure quality control:

- Loading and transporting all reef material to the site location
- Locating reef plots (using GPS) within the entire footprint and marking individual units
- Deploying only the specific rock size category within each marked unit until all four sizes (within one reef plot) have been placed according to reef specifications
- Verification of reef placement through SCUBA and/or other necessary methods (i.e. side-scan sonar). Additional small-scale adjustments to the reef may be necessary through the use of SCUBA divers.

The small scale of this project and the ease to which sites can be marked will minimize any potential construction impacts. Site 29 is not a highly productive area. Therefore, it is doubtful that construction impacts will be high on the marine species in the area and we expect the habitat enhancement project itself will mitigate for any construction impacts. Depth changes upon completion of the habitat enhancement project are expected be no greater than 54 inches from the addition of new bottom habitat. Adherence to reef specifications will be confirmed via post-installation side-scan sonar or multibeam survey and SCUBA surveys conducted by *MarineFisheries*.

Proposed Construction Timeline
Lobstermen generally fish less intensively in the winter. Therefore, we would prefer the reef construction to occur during March of 2006 in order to minimize user conflicts. In addition, construction of the reef in the winter will allow it to develop significant invertebrate and algal growth, which will encourage larval lobster and finfish settlement on it during its first year of deployment. Another advantage of winter construction is that it will minimize impacts to spawning migrations and periods of shellfish and lobster spawning activity.

No construction will occur until all permits are received and complete.

Example of the bottom type at Site 29

Current Status of the Permitting Process:

Received permits:

- Town of Beverly Order of Conditions (DEP File # 5-875)

    - Official letter sent to Beverly notifying them that the final site selected for this process was not in Beverly waters

- Town of Marblehead Order of Conditions (DEP File # 40-836)

    - Official letter sent to Marblehead notifying them that the final site selected for this process was not in Marblehead waters

- City of Boston Order of Conditions (DEP File # 006-1035)

    - Official letter sent to Boston notifying them that the final site selected for this process is in their waters

- Massachusetts Environmental Policy Act (MEPA) approval (File # 13605)

- Department of Environmental Protection Water Quality Certification (DEP # W066080)

Pending permits:

- Department of Environmental Protection Chapter 91 License (DEP # W05-1421)

- U.S. Army Corps of Engineers

Public Awareness and Outreach Activities:

- Sea Grant Science Symposium 2005: Lobsters as Model Organisms for Interfacing Behavior, Ecology, and Fisheries. Presented poster entitled: "Using GIS to Select Potential Sites for Habitat Enhancement in Massachusetts Bay."

- Worked with home-schooled children to educate them about local marine life and the habitat enhancement project

Upcoming Public Outreach:

- Quincy Coastal Commission, January 10, 2006

- Boston Harbor Lobstermen's Association, January 11, 2006

- Massachusetts Lobstermen's Association, February 3-5, 2006

- Boston Sea Rovers, March 3-5, 2006

- South Shore Lobstermen's Association, date pending